

Natural History Dioramas: An Opportunity for Children to Observe Science in Action in a Moment of Time

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ABSTRACT

The nature of scientific research goes beyond the learning of concepts and basic manipulation to the key factors of engaging students in identifying relevant evidence and reflecting on its interpretation. It is argued that young children have the ability to acquire viable, realistic concepts of the living world when involved in relevant activities (Tunnicliffe, 2000). Visiting a museum of natural history is an educational experience, which offers, children experiences that cannot be obtained within the classroom and research found that museums are excellent sources of cognitive experiences that complement and/or enrich the curriculum of formal education (Dillon et al., 2016). Dioramas have a specific context, which gives visitors the opportunity to be creative and have more learning opportunities when they engage with them (Achiam et al., 2014). This paper draws on data that were gathered at a natural history museum. These data were the spontaneous conversations of child visitors and a workshop with structured educational activities with a pre- and post-test research design, which provided the opportunity for children to observe science in action in a moment of time. These data focused on aspects of historical and experimental aspects of science in action shown in the positions and environments of the animals featured which may be identified in natural history dioramas.

KEY WORDS: natural history diorama; historical-experimental science; inquiry based science; context based learning

INTRODUCTION

There is a growing awareness that learning does not solely occur inside the school building. In the case of science, particularly for the basics of developing and understanding of the nature and content of science, this requires formal education, which is taught traditionally in classrooms and many instances laboratories. However, learning out of school in a variety of venues is a valuable aspect of learning both of and about science (Dillon, 2015). Dillon (2015) points out that science can be effectively learnt outside the classroom with visits to a variety of locations. Science can be learnt in other museums than those of science, particularly for biology in natural history museums.

It is recognized that family members, peers, and the media (Gatt et al., 2008; Tunnicliffe et al., 2008) are triggers in children's beginning to develop an awareness of phenomena which are "scientific." According to Russell and McGuigan (2016) some of the principles of science education are conceptual understanding, the "what" of science and the concept of scientific ideas. The science processes, the "how" of science requires knowing about and engaging in practical scientific inquiries. The acceptances of science knowledge, the "epistemic nature of scientific knowledge," the nature of science discourse, and the participation in scientific exchanges are all aspects of such learning.

Traditionally, museums have been viewed as places of learning, of culture, history and venues for the use of the educated

person, not ordinary people. Now, education is considered one of the main roles that a museum plays (NEMO, 2015). The conceptual map of learning in natural history institutions collections is a resource that can be drawn on by scientists, educators or visitors to advance their learning about the natural world. The content is the objects and collections, which are linked explicitly to core natural history content. Interpretation transforms collections, content and experience into learning opportunities that reflect the needs of the visitors. The audiences (visitors) are distinct groups who may engage with content, collections and expertise through facilitated experience. Visitors expect to see representations of the living world in natural history museums and especially the dioramas (Tunnicliffe et al., in press).

Dioramas are a genre of museum exhibit firmly in the museum world with tremendous, often as yet underused, educational potential (Tunnicliffe, 1995). According to Insley (2008), a diorama is a three-dimensional, life-size, simulated environment in which models or taxidermied animals are placed to depict a scene or an event. The diorama is a window that invites the visitor to discover. It displays objects interlinked in the manner in which they are in nature (Davallon et al., 1992).

Dioramas have a specific context that gives visitors the opportunity to be creative in their thought and have more learning opportunities when they are engaged with them (Achiam et al., 2014). The social context in which the dioramas

are viewed, the age of the learner and the reason for the visit all influence the way in which visitors respond to the dioramas. Children are creative thinkers. Recent research (Robson, 2014) has developed an approach referred to as the Analysing Children's Creative Thinking framework to identify and analyze young children's thinking. It identifies their creative thinking based on their own prior knowledge, which is evident in their interpretation of a scene in a diorama.

Kirchberg and Trondle (2012) carried out a review of visitor experiences from a literature survey and produced framework summarizing expectations. Therefore, visitors, whatever their motivation or reason why they arrive, undergo an experience of some kind. As Diamond (2000) discusses, museums offer visitors an experience, it may be visual, kinesthetic, or very much an esthetic one, emotive or educational. However, such experiences are unlikely to be ones in which they link with their everyday existence, because of the very nature of the museum which is providing the experience. Even if a visit is planned as part of a formal, educational curriculum visit, which the teacher deems an essential experience for their learners (Kiesel, 2003), such a visit is an experience different from their traditional education setting in a classroom.

Children experience and learn about science and build up their scientific repository from the earliest of years. The youngest of children observe think, investigate and act as intuitive scientists (Gopnik, 2009). Learning does not occur in a linear manner but is constructive, sometimes referred to as a spiral curriculum context, which is developed increasingly in more depth (Bruner, 1977). The starting point for science is observation. We consider that the process of acquiring such an essential foundation in the learning of science begins as a solo occupation, i.e., the child's persona, spontaneous science, then may develop further through a partnership with someone or thing else and finally may expand through more formal or designed experiences.

With the increasing emphasis with the museum fraternity of explaining, justifying history museums, their role in biological conservation of species and monitoring climate change, it can be argued that interpretation of exhibits such as natural history dioramas is in effect an outreach between scientists and their mediation to museum exhibits (Tunnicliffe and Scheersoi, 2011; Triquet and Laperriere 1999).

Exploring Science in Action

Museums are important social contexts where the visitors interact with the information about people and materials. Science is both a way of working and a body of knowledge (Ward and Roden, 2016). Science should be associated with curiosity and wonder about every aspect of the world including museums and especially natural history museums. Rodolph (2007) mentions that science has a variety of methods and techniques that scientist actually use to explore diverse phenomena. Science is what scientists do. Science offers chances for exploring, for observing novel objects, materials and events (Russell and McGuigan, 2016). However,

people rely on the content of their mental models to name or identify that which they are observing (Tunnicliffe et al., in press). Physical science concepts are acquired in different psychological domains and hence are different to biological concepts (Inagaki and Hatano, 2008).

Observing natural history dioramas spontaneously and then during a well-structured opportunity provide opportunities to identify science and more specifically physics in action, albeit at "a moment frozen in time" as Reiss and Tunnicliffe (2001) point out. Moreover, it is possible that visitors bring their own attitudes and ideas toward science, particularly when they observe dioramas in natural history museums.

METHODOLOGY

The methods of data collection used were to capture the spontaneous conversations and observations with audio recording by a voice recorder. Permission to record and observe had been obtained either before the visit if the school booked and/or on their arrival to the museum. The researchers elicited the visitors' conversations about the animals in a natural history museum in the South of England, which focuses on African and Indian dioramas. The transcript data were collected and analyzed through a read/re-read iterative process where categories emerged.

A workshop took place in the galleries of the natural history museum. Permission to participate, record and observed was gained before the workshop. On the participants' arrival to the museum, we confirmed their permission. The researchers used a pre-/post-test research approach by having a focus group at the beginning. Specifically for this paper, we focus on the pre-/post-test approach of the pilot study to explain the learning opportunities of the natural history dioramas in the learning of fundamental earth science.

Such data could usefully be analyzed further looking for clusters of interest which are what became apparent in our read/reread of summary of responses. Children as visitors attended the Powell-Cotton museum on different days, and conversation units of the dioramas of the museum's three galleries were collected. These conversations units were analyzed in this research. More specifically, 31 children were under 5-year-old (17 boys and 14 girls), 94 children between 5 and 6-year-old (43 boys and 51 girls), 31 children 7-year-old (18 boys and 13 girls), 11 children 8-year-old (3 boys and 8 girls), and 32 children 9-year-old (16 boys and 16 girls). The total number of spontaneous conversations analyzed was 167. The transcripts were collected with a digital voice recorder, and notes from the researchers were typed and then read and re-read until the categories emerged from the comments.

This research was a "two-phase study." During the first phase, an earth science workshop took place. This workshop was based on dioramas and outdoor observations, in which five children participated in during their holiday, 2 boys and 3 girls aged between 9 and 11. The data were collected with digital recorders and then transcribed. The three researchers worked

with one set of children each; two groups contained 1 boy and 1 girl chosen randomly and with the third group consisting of 1 girl. The research design was focused initially on observing the children's as they encountered the museum's dioramas. In the second phase, the children were asked to go outside and answer some open-ended questions such as, What can you see? What is below your feet? What is above you? What is the same level as you? What colors, textures and shapes can you observe? What sort of weather is today? Does the weather/climate of a place affect the place? Finally, the children were asked to return to the galleries and describe the dioramas taking into consideration their recently gained experience.

The Research Venue: The Galleries of Powell-Cotton Museum

This study reports on visitors who came to the Powell-Cotton Museum at Quex Park in Kent, England. This English gentleman's residence has been in the ownership of the same family since the 1550s. The present regency style house was built in 1813 after the former building was knocked down. This house was then enlarged in 1883. The house has formal gardens and is set in a 250-acre park. The Powell-Cotton Museum, a natural history museum whose strap line is "Where the past meets the present to change the future," was built by Major Percy Powell-Cotton. He was a pioneer in the use of the diorama to display mounted animals against backdrops of their natural habitats. The museum houses the animal specimens from Africa and India that he collected and brought back to this part of England (after being taxidermically treated) to show the local people, in the days before mass media, the diversity of living organisms and indeed various habitats to which the animals were adapted. Indeed, older local residents talked to his granddaughter now living at Quex Park with her family, about their memories of witnessing the arrival of the mounted specimens brought down by road from London from the taxidermist Rowland Ward. Their arrival was signaled by the ringing of the church bell. Compared with the local endemic wildlife of subdued hues, these exotic colorful animals, particularly the giraffe, lions and zebra were a wondrous invasion of color for the locals who lined the streets to witness the arrival of the latest animals (Johnson, Personal Communication, March 26, 2015). The museum has three galleries including a variety of species.

Gallery 1 displays the animals of the North and West Africa and India (Figure 1). Today, this is the first gallery visitors see on entering the museum. It was, however, the last gallery built by Percy Powell-Cotton himself, being completed in 1939 the year before his death. The large diorama to the left is known as "the watering hole" and represents many species from across Northern Nigeria and Chad. The central diorama showcases the amazing diversity of Africa's primates and the different landscapes they live in. The diorama to the back right of the gallery depicts animals from the Indian state of Madhya Pradesh (which translates as "Central Province"). The final diorama, to the right of the gallery, incorporates a variety of landscapes and animal habitats. The far left

represents the more lush woodlands around the Mkuze River, in Northern KwaZulu-Natal, South Africa. The central part of the diorama, formed of a high rocky crag, represents the Ethiopian Highlands, an area where land levels rarely fall below 1500 m. The Mountain Nyala displayed here, are only found in this region and have become a rare and endangered species. Finally, the desert habitat at the front of the case showcases the diversity of species found in the Sahara desert (Powell-Cotton Museum Gallery 1, 2017).

Gallery 2, called "The Pavilion," was the first gallery design and build by Percy Powell-Cotton and the starting point for his relationship with the taxidermist Rowland Ward, who helped build and design the museum's famous natural history dioramas (Figure 2). The gallery was completed in 1905, and the large Himalayan diorama is now considered the oldest untouched diorama of its type in any museum in the world. The diorama depicts the Himalayan landscape at dawn. The painted scenery looks down on the Baltoro Glacier, which is found today in the Gilgit-Baltistan region of Pakistan. Dioramas such as this were a new and innovative way of displaying natural history in the late 19th and early 20th centuries and very few dioramas of this quality or age are still standing in museums worldwide (Powell-Cotton Museum Gallery 2, 2017).

Gallery 3 was the second gallery to be built and was added on to the "Pavilion" in 1909 (Figure 3). The dioramas in this gallery focus on species from equatorial Africa and the



Figure 1: Gallery 1 of Powell-Cotton Museum (copyright Nikhilesh Havel. Reproduced courtesy of the trustees of the Powell-Cotton Museum)



Figure 2: Gallery 2 of Powell-Cotton Museum (copyright Nikhilesh Havel. Reproduced courtesy of the trustees of the Powell-Cotton Museum)

plains at the edge of these forested areas. The central diorama represents a lion and a buffalo and locked in battle. The large diorama of animals from equatorial Africa include one of the most impressive specimens - A the large bull elephant to the left of the case. In the same case is a truly rare sight – A group of the Northern White rhino (*Ceratotherium simum cottoni*) (Powell-Cotton Museum Gallery 3, 2017).

FINDINGS

Spontaneous Conversations

Results were obtained from an analysis of the spontaneous conversations of the children who visited the dioramas of the natural history. From these, we sought to identify the opportunity that the dioramas provided to children to observe science in action in a moment of time. Table 1 provides demographic descriptive statistics.



Figure 3: Gallery 3 of Powell-Cotton Museum (copyright Nikhilesh Havel. Reproduced courtesy of the trustees of the Powell-Cotton Museum)

Table 1: Age and numbers of comments made at the galleries of the Powell-Cotton Museum

Age	Total	Male	Female
>5 years (4-4 years, 11 months)	70	28	42
5/6 years	98	48	50
7 years	29	15	14
8 years	20	3	17
9 years	32	17	15
Total commentaries	249	111	138

This study investigates the sense children made of these various dioramas. 27 comments (9 boys and 18 girls) were collected at Gallery 1's "The Water Hole," 14 comments (3 boys and 11 girls) at Africa's primates, 35 comments (24 boys and 11 girls) at animals from India, and 29 comments (9 boys and 20 girls) about the variety of landscapes and animal habitats. In Gallery 2, 26 comments (14 boys and 12 girls) were collected at "The Pavilion." In Gallery 3, 31 comments (16 boys and 15 girls) were collected at the lion and buffalo standalone exhibit and 86 comments (39 boys and 47 girls) at Africa's animal diorama (Table 2).

As seen in Table 1, the most comments (98 out of 249) were made by the children between 5 and 6-year-old. The age group comprised those less than 5-year-old made 70 comments. The children who were 9-year-old make 32 comments and then the 7-year-old and 8-year-old with 29 and 20 comments, respectively.

Table 2 presents the comments made by each age group and in which diorama. This table provides us with an understanding of which dioramas impressed the children the most and how often features and items were mentioned in their spontaneous conversations. Interestingly, the younger ages were impressed most by the dioramas at Gallery 1 while, the older ages commented on all the dioramas.

Table 3 presents the descriptive statistics regarding the number of naming comments uttered out loud by the children. The age group under 5 made a total of 30 comments. A few more (38) were made by the children between 5 and 6-year-old. The children who were 9-year-old made 31 naming comments, and finally, 12 and 8 comments were made by the children who were 7 and 8-year-old, respectively.

Table 4 presents the number of comments other than naming which were inherently observational. Apart for the naming comments through our process of exploring the data, we discovered four other categories. These categories are the description of the structure/scene and resulted in 81 comments. Some examples are "the large elephant and the leopards trying to get away from the lion" (girl, 9 years), "zebras' body are

Table 2: Age and numbers of comments made at the galleries of the Powell-Cotton Museum

Age	>5 years			5/6 years			7 years			8 years			9 years		
	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F
Gallery 1 (dioramas)															
The watering hole	1		1	17	8	9				9	1	8			
Africa's primates	11	1	10	3	2	1									
Animals from India	32	23	9	1	1					2		2			
A variety of landscape and animals habitats	14	2	12	13	5	8							2	2	
Gallery 2															
The Pavilion	2	1	1	15	8	7	7	3	4				2	2	
Gallery 3															
Lion and buffalo	9	4	5	15	5	10	3	3					4	4	
Africa's animals					34	19	15	19	9	10	9	2	7	24	9
Total commentaries	70	28	42	90	48	50	29	15	14	20	3	17	32	17	15

covered with white and black" (girl, 4 years and 9 months), "the tiger has stripes, lots of stripes" (girl, 4 years and 10 months), and "tiger has sharp teeth" (girl, 5-year-old).

A second category was the 34 descriptions of animal behavior, such as "animals are playing and having fun" (girl, 5-year-old), "the animals getting ready and they are all looking one way" (boy, 7-year-old), "all the animals are fixing their gaze on them, and they are all watching the fight" (girl, 6-year-old).

The third category labeled "interpretation" included 78 comments. Some examples of these comments are "some of the animals look serious and some cute and fluffy" (girl, 8-year-old), "I don't like the snake over there because it is small and it does not look that real" (boy, 5-year-old), and "Oh look this antelope, it's cute" (girl, 6-year-old).

Finally, the last category is made up of those comments about the science process other than observational. In this category, 66 comments were uttered. Some examples are, "It tries to protect from the tiger. The tiger will attack it, that's why it is climbing at the tree" (boy, 4 years and 1 month), "the big elephant came along probably to eat their food" (girl, 9-year-old), and "That one there has been eaten, it looks like it's rotting because it's going purple" (boy, 7 years)."

Pilot Study: Earth Science Workshop

Table 5 presents the categories and the responses/comments of the pilot study of the earth science workshop. The first category was "soils/earth covering, soil, snow, water," where

at the pre-test there were no comments and at the post-test 6 comments (24%) were made. Such examples are "the ground is covering from sand," "the surface of the rocks is not rough but dusty." The second category is "adaptation to environment," where during the pre-test four responses (18%) were made with some of the most relevant examples being "rocky near the mountains," "the animals look the same way and have the same colors." During the post-test two responses were made (8%). These were "this corner of the diorama looks hotter because it does not have any plants" and "most of the animals have similar colors with the rocks. They camouflage." The third category refers to "physical things," where during the pre-test five responses (24%) were made such as "muddy river" and "canyon, rocky mountains." At the post-test four comments were made "it is a Canyon. There is a not plant apart from a tree. Is very high and it has strong winds." The forth category is referred to as "weather, sun, cloudy, sky, wind, rain, and snow as weather not habitat," during the pre-test two responses were made "it could be summer because the trees have leaves." During the post-test, 10 responses were made (40%). Examples of this category are "the weather is hot and dry," "there are mountains at the background of the diorama. It represents the area they (animals) leave and the colors are various. Green and brown, there will be water there," "in this diorama it rains very often if you look the plants and compare it with the other diorama." The last category referred to "habitat, desert, and forest." During the pre-test 10 comments (48%) were made such as, "there are a jungle and a desert." During the post-test three comments were made (12%) such as "desert, lack of rain," "soft sand."

The comments that were made during the post-test confirm our research focus, which refers to the opportunity the dioramas provided to the children who participated in the workshop to observe science in action in a moment of time. Furthermore, during this pilot study, and especially the earth science workshop, the children who participated made some comments relevant to the dioramas, which are worthwhile to

Table 3: Number of naming comments

Age	Total	Male	Female
>5 years (11 months)	30	14	16
5/6 years	38	23	15
7 years	12	6	6
8 years	8	2	6
9 years	31	13	18
Total commentaries	119	58	61

Table 4: Number of comments other than naming, which are inherently observational

Describe structure/scene	Describe behavior	Interpret (including affecting interpretation)	Science process (other than observational)
81 Girl, 5-year-old "tiger has sharp teeth"	34 Girl, 5-year-old "animals are playing and having fun"	78 Girl, 4 years and 11 months "the giraffe is very old"	66 Boy, 4 years and 1 month "it tries to protect from the tiger. The tiger will attack it, that's why it is climbing at the tree"
Girl, 4 years and 10 months "the tiger has stripes, lots of stripes"	Boy, 7-year-old "the animals getting ready and they are all looking one way"	Girl, 6-year-old "Oh look this antelope, it's cute"	Girl, 9-year-old "the big elephant came along probably to eat their food"
Girl, 4 years and 9 months "zebras' body are covered with white and black"	Girl, 6-year-old "all the animals are fixing their gaze on them, they are all watching the fight"	Boy, 5-year-old "I don't like the snake over there because it is small and it does not look that real"	Boy, 7 years "that one there has been eaten, it looks like it's rotting because it's going purple"
Girl, 9-year-old "the large elephant and the leopards trying to get away from the lion"		Girl, 8-year-old "some of the animals look serious and some cute and fluffy"	

Table 5: Categories and responses from the pilot study of the earth science workshop at Powell-Cotton museum

Categories	Pre	Examples	Post	Examples
	(n=21)		(n=25)	
Soils/earth covering, soil, snow, water	0/21 (0%)		6/25 (24%)	The ground is covering from sand The surface of the rocks are not rough but dusty (G1)
Adaptation to environment	4/21 (18%)	Rocky near the mountains The animals look the same way and have the same colors.	2/25 (8%)	This corner of the diorama looks hotter because it does not have any plants Most of the animals have similar colors with the rocks. They camouflage (G2)
Physical things	5/21 (24%)	Muddy river Canyon, rocky mountains	4/25 (16%)	It is a Canyon. There are not plants apart from a tree. Is very high and it has strong winds (G2)
Weather, sun, cloudy, sky, wind, rain, snow as “weather” not habitat	2/21 (10%)	The hippo (meant to look like water) It could be summer because the trees have leaves	10/25 (40%)	The weather is hot and dry (G1) There are mountains at the background of the diorama. It represents the area they (animals) leave, and the colors are various. Green and brown, there will be water there (G3) In this diorama (G3) it rains very often if you look the plants and compare it with the other diorama (G1)
Habitat, desert, forest	10/21 (48%)	There are jungle and desert Rocky mountains	3/25 (12%)	Desert, lack of rain (G1) Soft sand (G1)

G1, G2, and G3 refer to the group number where the comments were made

mention. Specifically, they noted, “all dioramas show different environments” (G1). “They put all the animals in the position where they are ... cool” (B1). “Each gallery tells you the specific story about the habitat and the landscape” (B2). “When you look at the diorama you see all the small details fit in a bigger picture” (G2). “The one who creates the diorama will like to give the feeling of separation about the weather” (G1 referring to Gallery 1’s dioramas).

DISCUSSION AND CONCLUSION

We begin by revisiting our research focus, i.e., the opportunity that dioramas provide to museum visitors, in different types of visits, to observe science in action in a moment of time and then discuss our findings.

In our studies in which the out loud observations of spontaneous conversations of children who visited the natural history dioramas and a pilot study of an earth science workshop, which took place at the same natural history dioramas, we found that dioramas were capable of prompting scientifically authentic comments regarding science. Furthermore, responses made by the visitors who participated in the study illustrated the way participants related to generate scientific comments in a context of the dioramas. The finding that scientific objects, such as dioramas, are capable of promoting activity and scientific comments related to science is not new (Dierking and Holland, 1996; Gurian, 1999). However, what is significant here is that this may happen either in spontaneous conversations or through being prompted through participation in a well-structured workshop. The depth of content of the responses depends on the age, the educational needs and the area of science being explored.

Physical science principles are implicit in observing the living world and these life-sized representations of a moment in time, whether a faithful representation of a known scene or

a conceptual construction diorama illustrating biogeographic principles, provide such an opportunity (Tunnicliffe et al., in press).

The results of this study show that crossover learning in informal settings, such as museums, can link to educational contexts. Authentic experiences such as museum visits and the interaction with the dioramas support visitors with meaningful content in addition to their formal curriculum. The study of informal education is seen as particularly critical because all the members of the families seem to build much of their knowledge about the world around them using as resources natural history dioramas.

Collecting and the subsequent analysis of spontaneous group conversations generated at museum exhibits, in this case, natural history dioramas, can, it seems to us, to be the most effective means of our understanding these visitors’ interpretation of the representation of the exotic natural world, linking such with science. The objects, participants and the research question together formed the rich setting that gave rise to what Dierking (2002) described as the contextually driven effort to find meaning in the real world. Dierking observed how such meaning making cannot easily be decontextualized from the direct experience with the object. Indeed, in this study, we saw how the objects helped define the task and provided the participants with knowledge that would likely have been unavailable from their existing mental representation alone (Zhang and Patel, 2006; Achiam et al., 2016).

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